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A Comparison Study Of Cu(II) Adsorption Between TDI-LFG and 4TDI-LFG Polymers

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Abstract

In this study, a 4TDI-LFG polymer was used to remove Cu(II) ions from aqueous solutions. The TDI amount of previously synthesized polymer (TDI-LFG) was changed and the 4TDI-LFG polymer was prepared. The effect of pH, stirring time, polymer dose and initial metal concentration on the Cu(II) adsorption by 4TDI-LFG have been investigated with batch adsorption experiments. The influence of different TDI amounts in the polymer content were evaluated.

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Keywords: Cu(II) adsorption, polymer, TDI.

1. Introduction

Even though heavy metals have countless harmful effects to living beings, people continue to use them in many areas such as electroplating, galvanizing, textile, leather, metallurgical and other metal and refining processes (Järup 2003, Ahluwalia and Goyal 2007). Copper is one of heavy metals and found in many enzymes and proteins, but cause poisoning in humans and animals over the required dose (Değirmen *et al.* 2012). The waste water containing copper has been purified by methods such as precipitation, electrocoagulation (Cheng 2006), ion exchange (Dąbrowski *et al.* 2004), evaporation and electrolysis (Gyliene *et al.* 2004). Among this methods the adsorption is a method applied in the copper removal with a variety of adsorbent (Panday *et al.* 1986, Bereket, Gözen; Aroğuz, Ayşe; Özel 1997, Kadirvelu *et al.* 2000). In this study, the effect of pH, effect of mixing time, the effect of polymer dose and the effect of initial metal concentration on Cu(II) adsorption by 4TDI- LFG polymer and the influence of different TDI amount in the polymer content on Cu(II) adsorption was evaluated.

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2. Experimental studies

2.1. Synthesize of polymer

The same procedure was followed with previously synthesized and described polymer (Ozer *et al.* 2014) as just used amount of TDI was extracted 4 times. The solution was mixed continuously at room temperature for four and a half hours using a mechanical stirrer and polymer was observed to collapse. The resulting polymer was filtered and washed with distilled water to draw off solvent and then washed in ethanol and ether.

2.2. Batch Experiments

Study of the Cu(II) adsorption conditions of the 4TDI-LFG polymer was carried out using batch experiments. Thus, 50 mg of polymer was placed in a flasks with 50 mL of the Cu(II) solutions at different pH, stirring time and initial concentrations. The residual concentrations of Cu(II) ions were measured with an ICP (Spectro, Arcos FHE16). The amount of adsorbed Cu(II) ions by (4TDI-LFG) was calculated with following equation (Yu *et al.* 2013):

$$q_e = (C_0 - C_e)\frac{V}{m} \quad (1)$$

Where q_e is the amount of adsorbed Cu(II) per unit weight within polymer (mg/g), C_0 is the initial concentration of Cu(II) solution (mg/L), C_e is the equilibrium concentration of the solutions (mg/L), m and V are the amount of polymer (m) and volume of solution (mL), respectively.

2.3 Adsorption Studies

In order to examine the Cu(II) adsorption dependence on pH with (4TDI-LFG) polymer, pH studies were performed in the 1-6 range with the concentration of 50 mg/L and dose of 50 mg. The pH value was determined to be 6.0 for other experiments.

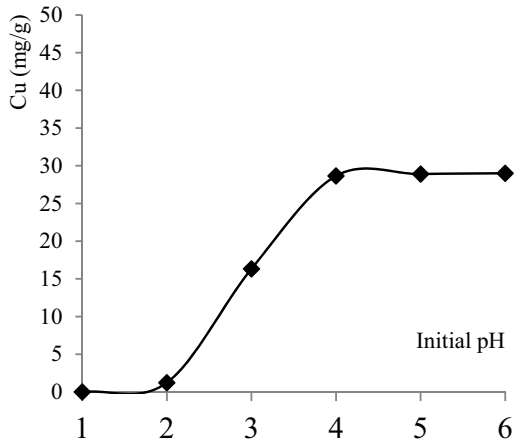

Figure 1. Effect of pH.

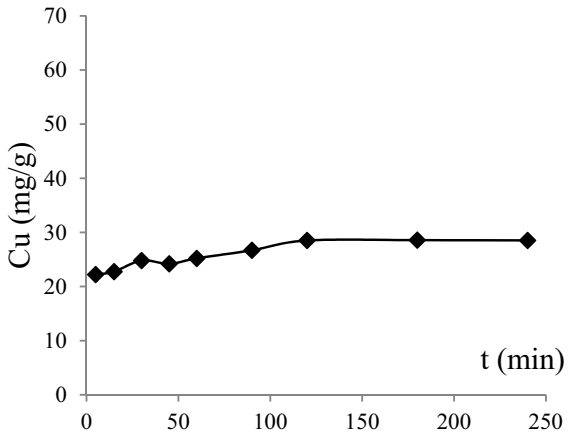

Figure 2. Effect of mixing time.

The solutions stirred at varying time period between 5 and 240 minutes were used to see the effect of mixing time. After the first 120 minutes, there was no change in the amount of adsorbed Cu(II) therefore optimum mixing time was determined as 120. The results obtained from pH and mixing time studies were given in Figure 1 and 2, respectively.

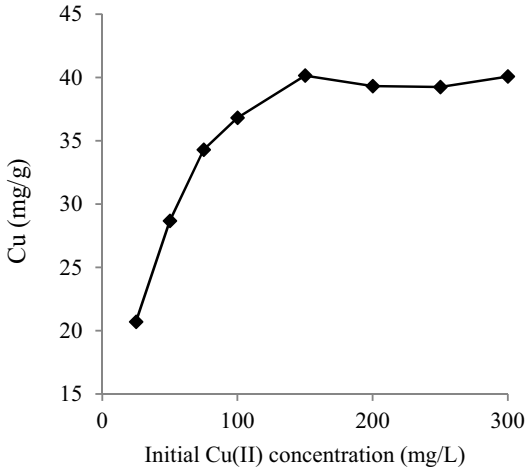

Figure 3. Effect of initial concentration.

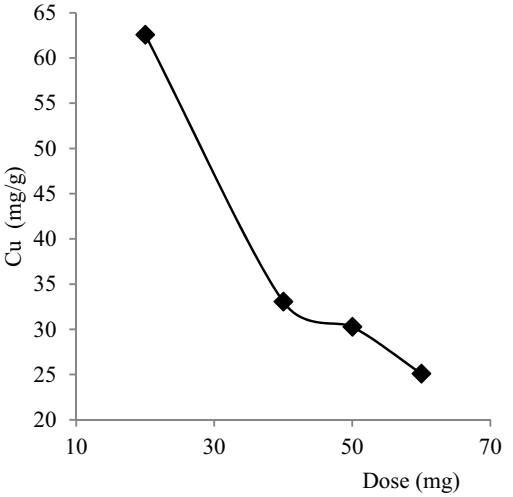

Figure 4. Effect of polymer dose.

Figure 3 displays the effect of initial Cu(II) concentration on adsorption with 4TDI- LFG polymer. It is observed that adsorbed Cu(II) amount changes with increasing metal ion concentration in the range from 25 to 150 mg/L. A negligible change was observed at value of $q_{e,}$ after concentration of 150 mg/L.

The effect of polymer dose on Cu(II) adsorption was studied with varying amounts of 4TDI- LFG (20-60 mg). The adsorbed amount of Cu(II) on per unit mass of adsorbent was found to decrease when the dose increased. The experimental results are shown in Figure 4.

3. Conclusions

In this study, the effect of pH, effect of mixing time, the effect of polymer dose and the effect of initial metal concentration on Cu(II) adsorption by 4TDI- LFG polymer were investigated. The comparison results of the Cu (II) ion adsorption studies with 4TDI- LFG polymer and TDI- LFG polymer, which was described in another paper, are as follows.

- pH value and contact time were detected the same (pH=6.0 and 120 min) for both of polymers,
- The effects of initial metal ion concentration and the polymer dose on Cu(II) adsorption with both polymers were observed to be similar,
- In the same conditions (pH=6.0, C_0= 50 mg/L, polymer dose 50 mg, V=50 mL) , q_e value was found to be higher with TDI-LFG polymer than 4TDI-LFG,
- According to observed results from two studies, it is decided to continue the following studies with TDI-LFG polymer.

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